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Indian Standard

SPECIFICATION FOR FIXED METALLIZED POLYCARBONATE FILM DIELECTRIC CAPACITORS

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

UDC 621·319·4 : 621·315·616·96-416 [678·046·34] : 620·1

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Indian Standard

SPECIFICATION FOR FIXED METALLIZED POLYCARBONATE FILM DIELECTRIC CAPACITORS

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

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Indian Standard

SPECIFICATION FOR
FIXED METALLIZED POLYCARBONATE FILM DIELECTRIC CAPACITORS

PART 1 GENERAL REQUIREMENTS AND METHODS OF TESTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 November 1985, after the draft finalized by the Capacitors Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard (Part 1) is to establish uniform requirements for judging the electrical, mechanical and climatic properties of fixed metallized polycarbonate film dielectric capacitors, used in electronics and telecommunication equipment.

0.3 This standard (Part 1) requires reference to IS : 7305-1984* in which details of various tests prescribed have been fully covered. Only the appropriate degrees of severity and any other special conditions relating to certain tests have been included in this standard.

0.4 While preparing this standard assistance has been derived from IEC Doc : 40 (C.O.) 588 Draft — Revision of IEC Pub 384-6 : Fixed capacitors for use in electronic equipment: Part 6 Sectional specification: Fixed metallized polycarbonate film dielectric direct current capacitors — Adaptation of the standard to the requirements for quality assessment systems for electronic components, issued by the International Electrotechnical Commission (IEC).

1. SCOPE

1.1 This standard (Part 1) applies to fixed capacitors for direct current with metallized electrodes and polycarbonate dielectric for use in electronic equipment. These capacitors may have ‘self-healing properties’ depending on conditions of use.

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*Specification for fixed capacitors used in electronic equipment (*first revision*).

1.2 The capacitors covered by this standard are primarily intended for applications where the ac component is small with respect to the rated voltage. Two performance grades of capacitors are covered — Grade 1 for long-life applications and Grade 2 for general applications.

2. TERMINOLOGY

2.1 For the purpose of this standard, following terms and definitions, in addition to those given in IS : 1885 (Part 45)-1977* shall apply.

2.2 **Performance of Grade 1 Capacitors (Long Life)** — Capacitors for long life applications with stringent requirements for the electrical parameters.

2.3 '**Performance of Grade 2 Capacitors (General Purpose)** — Capacitors for general applications where the stringent requirements for Grade 1 capacitors are not necessary.

2.4 **Rated Voltage** -The rated voltage is the maximum dc voltage, which may be applied continuously to a capacitor at the rated temperature.

NOTE -The sum of the dc voltage and the peak ac voltage applied to the capacitor shall not exceed the rated voltage. The values of the peak ac voltage shall not exceed the following percentage of the rated voltage at the frequencies stated and shall not be greater than 280 V :

50 Hz : 20 percent
100 Hz : 15 percent
1000 Hz : 3 percent
10000 Hz : 1 percent

Unless otherwise specified in the detail specification.

3. CLIMATIC CATEGORIES

3.1 The capacitors covered by this standard shall be classified into climatic categories with the lower and upper category temperatures and the duration of the damp heat steady state chosen from the following:

Lower category temperature : —55°C, – 40°C, – 25°C
Upper category temperature : +85°C, + 100°C and + 125°C
Duration of damp heat 4, 10, 21 and 56 days

NOTE -With continuous operation at 125°C in excess of the endurance test time, accelerated ageing has to be considered.

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* Electrotechnical vocabulary: Part 45 Capacitors.

4. RATINGS

4.1 Rated Capacitance (C_R) - The preferred values of rated capacitance are : 1, 1·5, 2·2, 3.3, 4·7, and 6 8 and their decimal multiples.

NOTE — These values conform to the E6 series of preferred values given in IS : 824-1965*. If other values are required they shall preferably be chosen from El2 series.

4.2 Tolerance on Rated Capacitance — The preferred tolerances on the rated capacitance are ± 5 percent, ± 10 percent and ± 20 percent.

4.3 **Rated Voltage (U_R)** — The preferred values of rated voltage are 40-63-100-160-250-400-630-1000-1 600 V.

NOTE -These values conform to the basic series of preferred values R5 given in IS : 1076-1967†.

4.4 **Category Voltage (U_C)** — The category voltage is:

0.8 U_R for upper category temperature 100°C, and

0·5 U_R for upper category temperature 125°C.

4.5 **Rated Temperature** — The standard value of rated temperature is 85°C.

5. CONSTRUCTION AND WORKMANSHIP

5.1 The construction, workmanship and finish shall be in accordance with 6 of IS : 7305-1984‡.

6. DIMENSIONS

6.1 The dimensions and their associated tolerances shall be as specified in the relevant detail specification.

7. MARKING

7.1 The information given in the marking shall be selected from the following; the relative importance of each item being indicated by its position in the list:

a) Rated capacitance (may be indicated by the code given in IS : 8186-1976§);

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*Preferred values for resistors and capacitors (*revised*).

†Preferred numbers (*first* revision).

‡Specification for fixed capacitors used in electronic equipment (*first revision*).

§Marking codes for values and tolerances of resistors and capacitors.

b) Rated voltage (dc voltage may be indicated by the symbol ⎓ or —);

c) Tolerance on rated capacitance (may be indicated by the code given in IS : 8186-1976*);

d) Category voltage;

e) Year and month (or week) of manufacture (may be indicated by the codes given in IS : 8186-1976*);

f) Manufacturer's name or trade-mark;

g) Climatic category;

h) Manufacturer's type designation;

j) Reference to application grade; and

k) Style reference.

7.2 The capacitor shall be clearly marked with 7.1 (a), (b) and (c) and with as many as possible of the remaining items as is considered necessary.

7.3 The package containing the capacitors, shall be clearly marked with all the information listed in 7.1.

7.4 Any additional marking shall be so applied that no confusion arises.

7.5 The capacitors may also be marked with the ISI Certification Mark.

NOTE — The use of the IS1 Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by IS1 and operated by the producer. IS1 marked products are also continuously checked by IS1 for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the IS1 Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8. TESTS

8.1 Classification of Tests

8.1.1 *Type Tests*

8.1.1.1 *Number of samples* — The number of samples to be tested in each group or subgroup together with the permissible number of defectives shall be as given in Table 1.

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*Marking codes for values and tolerances of resistors and capacitors.

TABLE 1 SCHEDULE OF TYPE TESTS

(*Clause* 8.1.1.1)

GROUP	TEST	CLAUSE REFERENCE	NUMBER OF SPECIMENS (n) AND NUMBER OF PERMISSIBLE DEFECTIVES (pd)						
			Per† value n	For four or less values to be tested†			For six values to be tested‡		
				4n	pd	pd total	6n	pd	pd total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0	Visual examination Dimensions Capacitance Tangent of loss angle Voltage proof Insulation resistance	8.4.1 8.4.2 8.3.2 8.3.3 8.3.1 8.3.4	29	116	2†		174	3†	
	Spare specimens		2	8			12		
1A	Robustness of terminations Resistance to soldering heat	8.4.3 8.4.4.2		12	1	4	18	1	6
1B	Solderability Rapid change of temperature Vibration Bump or shock*	8.4.4.1 8.5.3 8.4.5 8.4.6 or 8.4.7		24	1		36	2†	
1	Climatic sequence	8.5.1	9	36	2		54	3	
2	Damp heat, steady state	8.5.2	5	20	1		30	2†	
3	Endurance	8.6	10	40	2†		60	3†	
4	Characteristics depending on temperature* Charge and discharge	8.3.6 8.3.5	5	20	1		30	2	

*As required in the detail specification.

†Not more than one defective is permitted from any one value.

‡Capacitance-voltage combinations (*see* 8.1.1.2).

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8.1.1.2 *Selection of sample* — The samples shall be representative of the range of capacitors of the type under consideration. The sample shall consist of specimens having the lowest and highest voltages, and for these voltages the lowest and highest capacitances. When there are more than four rated voltages an intermediate voltage shall also be tested. Thus for the approval of a range, testing is required of either four or six values (capacitance/voltage combinations). When the range consists of less than four values, the number of specimens to be tested shall be that required for four values.

Spare specimens are permitted as follows:

a) One per value which may be used to replace the permitted defective in Group 0.

b) One per value which may be used as replacements for specimens which are defective because of incidents not attributable to the manufacturer.

NOTE — A capacitor subjected to the type tests according to Table 1 or to any part of them which may be considered destructive, shall not beuscd in equipment or returned to the bulk supply.

8.1.1.3 *Schedule of type tests* — The capacitors shall be subjected to the tests specified in Table 1, in the order given. After the completion of the tests specified in Group 0, the sample shall be divided into four groups for further testing. Specimens found defective during the tests of Group 'O' shall not be used for the other groups.

8.1.2 *Routine Tests -The* following tests shall be performed on each and every capacitor:

a) Visual examination,

b) Voltage proof (as a flash test), and

c) Capacitance.

8.1.3 *Acceptance Tests* — From the lot which has passed routine tests two groups of the samples (Group A and Group B) shall be selected and capacitors in each group shall be subjected to the tests specified in Table 2 in the order given. The sample tested shall be representative of the values and dimensions contained in the lot with a minimum of five of any one value.

8.2 **General Conditions for Tests** — The general conditions for tests shall be as specified in 8.2 of IS :7305-1984*.

***Specification for fixed capacitors used in electronic equipment** (*first revision*).

TABLE 2 SCHEDULE OF ACCEPTANCE TESTS

(Clause 8.1.3)

TEST	CL REF	AQL (PERCENT DEFECTIVE)	INSPECTION* LEVEL	D/ND
(1)	(2)	(3)	(4)	(5)
Group *A*				
Subgroup A I:		2·5	s-4	*ND*
Visual examination	8.4.1			
Dimensions	8.4.2			
Subgroup A 2 :		1·0	II	*ND*
Capacitance	8.3.2			
Tangent of loss angle	8.3.3			
Voltage proof	8.3.1			
Insulation resistance	8.3.4			
Group *B*				
Subgroup B I:		2·5	s-3	*D*
Solderability	8.4.4. 1			

ND = **Non-destructive** *D* = **Destructive**

‘IS : 10673-1983 Sampling plans and procedures for inspection by attributes for electronic items.’

8.3 Electrical Tests

8.3.1 *Voltage Proof* — This test shall be carried out in accordance with 8.3.1 of IS :7305-1984* with the following details.

8.3.1.1 ***Test circuit*** — Delete the capacitor C_1. The product of R_1 and the rated capacitance C_X shall be less than or equal to 1 s and greater than 0·01 s. R_1 includes the internal resistance of the power supply. R_2 shall limit the discharge current to a value equal to or less than IA.

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*Specification for fixed capacitors used in electronic equipment (*first* revision).

8.3.1.2 The following voltages shall be applied between the measuring points of Table 1 in 8.3.1.5 of IS : 7305-1984* for a period of 1 minute.

Test Point	*Test voltage*
A	Grade 1 : 1·6 U_R Grade 2 : 1·4 U_R
B and C	2 U_R with a minimum of 200 V

NOTE — The occurrence of self-healing breakdowns during the application of the test voltages is allowed.

8.3.1.3 When required as a flash test, the dc voltage shall be applied for two seconds.

8.3.2 *Capacitance* — This test shall be carried out in accordance with 8.3.2 of IS : 7305-1984*.

8.3.2.1 The capacitance shall be measured at, or corrected to, a frequency of 1 kHz. For rated capacitance values > 10 µF, 100 Hz may be used. The applied. peak voltage at 1 KHz shall not exceed 3 percent of the rated voltage and the applied peak voltage at 100 Hz shall not exceed 20 percent of the rated voltage with a maximum of 100 V (70 V rms).

8.3.2.2 The capacitance shall be within the specified tolerance.

8.3.3 Tangent *of Loss Angle* — This test shall be carried out in accordance with 8.3.3 of IS :7305-1984* with the following details.

8.3.3.1 Measuring conditions for measurements at 1 KHz.

Frequency : 1 KHz

Peak voltage : ⩽ 3 percent of the rated voltage

Inaccuracy : ⩽ 5×10^{-4} (absolute value)

8.3.3.2 *Requirements for measurements at 1 KHz-Tan* δ shall not exceed the following:

Rated capacitance	*Tan δ (Absolute Value)*	
	Grade 1 Capacitors	Grade 2 Capacitors
⩽ 1 µF	0.003	0’005
> 1 µF	0’005	0·008

8.3.3.3 Measuring conditions for measurements at 10 KHz

Frequency : 10 KHz

Voltage 1 V r.m.s. maximum

Inaccuracy : ⩽ 5×10^{-4} (absolute value)

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*Specification for fixed capacitors used in electronic equipment (*first* **revision**).

8.3.4 *Insulation Resistance* — This test shall be carried out in accordance with 8.3.6 of IS : 7305-1984* with the following details.

8.3.4.1 Before measurement the capacitor shall be fully discharged. The product of the resistance of the discharge circuit and the rated capacitance of the capacitor under test shall be ⩾0·01 s unless otherwise specified in the detail specification.

8.3.4.2 The measuring voltage shall be in accordance with 8.3.6.2 of IS : 7305-1984*. The voltage shall be applied immediately at the correct value through the internal resistance of the voltage source. The product of the internal resistance and the rated capacitance of the capacitor shall be smaller than 1 s, unless otherwise specified in the detail specification.

8.3.4.3 *Rrquirement* — The insulation resistance shall meet the following requirements.

(*R* = Minimum RC product insulation resistance between the terminations) (*C* = rated capacitance) (s)				Minimum insulation resistance between the terminations (MΩ)				Minimum insulation resistance between terminations and case (MΩ)
Measuring points in accordance with 8.3.1.								
1a)				1a)				1b) 1c) 1d)
Rated capacitance:								
>0·33 µF				⩽0·33 µF				
Rated voltage:								
>100 V		⩽100 V		>100 V		⩽100 V		
Grade:								
1	2	1	2	1	2	1	2	
10000	2 500	5 000	1 250	30 000	7 500	15000	3 750	30 000

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*Specification for fixed capacitors used in electronic equipment (*first* revision).

8.3.4.4 Where the test is carried out at a temperature other than 20°C, the result shall, where necessary, be corrected to 20°C by multiplying the result of the measurement by the appropriate correction factor. In case of doubt measurement at 20°C is decisive. The following correction factors may be considered as an average:

Temperature (°C)	*Correction Factor*
15	0·90
20	1·00
23	1·05
27	1·15
30	1.20
35	1·30

8.3.5 Charge and Discharge — This test shall be carried out in accordance with 8.3.9 of IS : 7305-1984* with the following details.

8.3.5.1 Initial *measurement -The* capacitance and tangent of loss angle shall be measured.

8.3.5.2 The capacitors shall be subjected to 10 000 cycles of charge and discharge at a rate of approximately one cycle per second. Each cycle shall consist of charging and discharging the capacitors. Each capacitor shall be individually charged with the rated voltage through a resistor with a value $\frac{220 \times 10^{-6}}{G}$ Ω, where C_R is the rated capacitance in farads or the value required to limit the charge current to 1A (or to the higher current value given in the detail specification), whichever resistance value is greater.

Each capacitor shall be individually discharged through a resistor with a value of $\frac{10 \times 10^{-6}}{CR}$ Ω with a minimum of 20 Ω or a lower value when prescribed in the detail specification.

8.3 5.3 Final measurements and requirements — The capacitors shall meet

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***Specification for fixed capacitors used in electronic equipment** (*first* **r&ion**).

the following requirements:

Measurement	*Method of Measuring*	*Requirtment*
Capacitance	*8.3.2*	The percentage difference between the capacitances measured finally and in 8.3.5.1 shall not exceed 2 percent for Grade 1 capacitors and 3 percent for Grade 2 capacitors
Tangent of loss angle	8.3.3.1	The increase of tan δ with respect to' tan δ measured in 8.3.5.1 shall be: $\leqslant 0{\cdot}003$ for $C \leqslant 1\ \mu F$, Grade 1 $\leqslant 0{\cdot}002$ for $C > 1\ \mu F$, Grade 1 $\leqslant 0.005$ for $C \leqslant 1\ \mu F$, Grade 2 $\leqslant 0{\cdot}003$ for $C > 1\ \mu F$, Grade 2
Insulation resistance	8.3.4	The insulation resistance shall be not less than 50 percent of the applicable value in 8.3.4.3.

8.3.6 *Characteristics depending on temperature (* If required in the detail specification)-This test shall be carried out in accordance with 3.3.12.1 of IS : 7305-1984* with the following details.

The capacitance measurements shall be carried out at points b, c, and e. The measurement of insulation resistance is also carried out at point e, of test temperature.

Characteristics at Lower Category Temperature

Test temperature at point b	Temperature characteristic of capacitance
− 10°C and − 25°C:	$0 \leqslant \frac{\Delta C}{C} \leqslant -1$ percent
− 40°C	$0 \leqslant \frac{\Delta C}{C} \leqslant -2$ percent
− 55°C	$0 \leqslant \frac{\Delta C}{C} \leqslant -3$ percent

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*Specification for fixed capacitors used in electronic equipment (*first* revision).

Characteristics at Upper Category Temperature

Test temperature at point e	Temperature characteristic of capacitance
85°C	$-1{\cdot}5$ percent $\leqslant \frac{\Delta C}{C} \leqslant +1{\cdot}5$ percent
100°C	-2 percent $\leqslant \frac{\Delta C}{C} \leqslant +2$ percent
125°C	-4 percent $\leqslant \frac{\Delta C}{C} \leqslant +4$ percent

For Grade 1 capacitors only the insulation resistance shall be measured and shall meet the requirements given below.

Measuring points	Climatic category	Insulation resistance measured at point e of test temperature				
		Between terminations				Between terminations and case
		RC product (s)		Minimum resistance (MΩ)		Minimum resistance (MΩ)
		Rated capacitance				
		> 0·33 µF		⩽ 0.33 µF		
		Rated voltage				
		> 100 V	⩽ 100 V	> 100 V	⩽ 100 V	
1a	-/125/- -/100/- -/085/-	12 66 200	6 33 100	40 200 600	20 100 300	
1b	-/125/- -/100/- -/085/-	—	—	—	—	40 200 600

8.4 Physical and Mechanical Tests

8.4.1 *Visual Examination* — The capacitors shall be visually examined for compliance with the requirements of marking and finish.

8.4.2 *Dimensions* — The dimensions and their associated tolerances shall be checked for compliance with those specified in the relevant specification.

8.4.3 *Robustness of Terminations* — This test shall be carried out in accordance with 8.4.4 of IS : 7305-1984*, with following details.

8.4.3.1 *Initial measurement*-The capacitance and tangent of loss angle shall be measured.

8.4.4 *Soldering*

8.4.4.1 Solderability -Unless otherwise prescribed, this test shall be carried out in accordance with 8.4.5.1 of IS :7305-1984* using either the solder globule method or the solder bath method, with the following deviations:

a) No ageing is required,

b) The requirements for the solder globule test method shall be prescribed in the detail specification, and

c) Where neither the solder bath nor the solder globule method is appropriate the soldering iron test shall be used with soldering iron size A.

NOTE — The thermal shock test is not applicable.

Requirement : The tinning shall be good and uniform as evidenced by the free flowing of the solder with wetting of the terminations.

8.4.4.2 *Resistance to soldering heat* — Unless otherwise specified, this test shall be carried out in accordance with 8.4.5.2 of IS :7305-1984* without any predrying.

Final measurements and requirements — The capacitors shall be inspected and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirement*
Visual examination	8.4.1	There shall be no visible damage
Capacitance	8.3.2	The percentage difference between the capacitance measured finally and in 8.3.2 shall not exceed 1 percent for Grade 1 and 2 percent for Grade 2 capacitors

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*Specification for fixed capacitors used in electronic equipment (*first revision*).

Measurement	*Measuring Method*	*Requirement*
Tan δ	8.3.3.1	The increase of tan δ with respect to tan δ measured in **8.3.3.1** shall be: $\leqslant$ 0·003 for C $\leqslant$ 1 μF Grade 1 $\leqslant$ 0·002 for C $>$ 1 μF Grade 1 $\leqslant$ 0·005 for C $\leqslant$ 1 μF Grade 2 $\leqslant$ 0·003 for C $>$ 1 μF Grade 2

8.4.5 *Virbration* — This test shall be carried out in accordance with **8.4.6** of IS : 7305-1984* with the following details.

8.4.5.1 No initial measurements shall be made.

8.4.5.2 The severities shall be as specified in the relevant detail specification chosen from the following:

Frequency (Hz)	*Peak Value of Vibration Amplitude + 10 percent*	*Duration*
10-2 000	0·75 mm or 100 m/s^2 whichever is less	6 hours
10- 500	0·75 mm or 100 m/s^2 whichever is less	
10- 55	0·75 mm or 100 m/s^2 whichever is less	

8.4.5.3 The detail specification shall also prescribe the mounting method to be used. For capacitors with axial leads and intended to be mounted by the leads only, the distance between the body and the mounting point shall be 6 ± 1 mm.

8.4.5.4 *Final measurements and requirements* — The capacitors shall be inspected and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirement*
Visual examination	8.4.1	There shall be no visible damage
Capacitance	8.3.2	The percentage difference between the capacitances measured finally and in **8.3.2** shall not exceed 2·5 percent for Grade 1 and 4 percent for Grade 2 capacitors

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*Specification for fixed capacitors used in electronic equipment (*first revision*).

Measurement	*Measuring Method*	Requirement
Tan δ	**8.3.3.1**	The increase of tan δ with respect to tan δ measured in 8.3.3.1 shall be: $\leqslant 0{\cdot}003$ for $C \leqslant 1\ \mu F$ Grade 1 $\leqslant 0{\cdot}002$ for $C < 1\ \mu F$ Grade 1 $\leqslant 0{\cdot}005$ for $C \leqslant 1\ \mu F$ Grade 2 $\leqslant 0{\cdot}003$ for $C > 1\ \mu F$ Grade 2
Insulation resistance	8.3.4	The insulation resistance shall be not less than 50 percent of the applicable value in 8.3.4.3

8.4.6 *Bump* — This test shall be carried out in accordance with 8.4.7 of IS : **7305-1984*** with the following details.

8.4.6.1 No initial measurements shall be made. The detail specification shall state which of the following severities applies:

Total number of bumps — 1000 or 4 000

Acceleration — 400 m/s^2 or 100 m/s^2

Pulse duration — 6 **ms**

The detail specification shall also prescribe the mounting method to be used for capacitors with axial leads and intended to be mounted by the leads only, the distance between the body and the mounting point shall be 6 ± 1 mm.

8.4.6.2 *Final measurements and requirements* — The capacitors shall be inspected and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirement*
Visual inspection	8.4.1	There shall be no visible damage
Capacitance	8.3.2	The percentage difference between the capacitances measured finally and in 8.3.2 shall not exceed 2·5 percent for Grade 1 and 4 percent for Grade 2 capacitors

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***Specification for fixed capacitors used in electronic equipment (*first revision*).**

Measurement	*Measuring Method*	*Requirement*
Tan δ	*8.3.3.1*	The increase of tan δ with respect to tan δ measured in 8.3.3.1 shall be: $\leqslant$0·003 for C $\leqslant$ 1 μF Grade 1 $\leqslant$0·002 for C > 1 μF Grade 1 $\leqslant$0·005 for C $\leqslant$ 1 μF Grade 2 $\leqslant$0·003 for C < 1 μF Grade 2
Insulation resistance	8.3.4	The insulation resistance shall be not less than 50 percent of the applicable value in 8.3.4.3.

8.4.7 *Shock* — This test shall be carried out in accordance with 8.4.8 of IS : 7305-1984* with the following details.

8.4.7.1 No initial measurements shall be made. The detail specification shall state which of the following severities applies.

Pulse *shape — half sine* *Peak acceleration*	*Corresponding duration of the pulse*
300 m/s^2	18 ms
500 m/s^2	11 ms
1 000 m/s^2	6 ms

8.4.7.2 ***Final*** *measurements and requirements* — The capacitors shall be **inspected** and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirement*
Visual **inspection**	8.4.1	There shall be no visible damage
Capacitance	8.3.2	The percentage difference between the capacitance measured finally and in 8.3.2 shall not exceed 2·5 percent for Grade 1 and 4 percent for Grade 2 capacitors
Tan δ	8.3.3.1	The increase of tan δ with respect to tan δ measured in 8.3.3.1 shall be: $\leqslant$0·003 for C $\leqslant$ 1 μF Grade 1 $\leqslant$0·002 for C > 1 μF Grade 1 $\leqslant$0·005 for C $\leqslant$ 1 μF Grade 2 $\leqslant$0·003 for C < 1 μF Grade 2
Insulation resistance	8.3.4	The insulation resistance shall be not less than 50 percent the applicable value in 8.3.4.3.

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*Specification **for fixed** capacitors **used in electronic equipment** (***first revision***).

8.5 Climatic Tests

8.5.1 ***Climatic Sequence*** -This test shall be carried out in accordance with 8.5.1 of IS : 7305-1984* with the following details.

8.5.1.1 ***Initial measurements* — *No*** initial measurements shall be made.

8.5.1.2 *Dry* heat-This test shall be carried out in accordance with 8.5.1.2 of IS : 7305-1984* with the following details.

Duration : 16 h, at upper category temperature

8.5.1.3 ***Damp heat cyclic* (*first cycle*) *-This*** test shall be carried out in accordance with 8.5.1.3 of IS : 7305-1984*.

8.5.1.4 ***Cold-*** This test shall be carried out in accordance with 8.5.1.4 of IS : 7305-1984* with the following details.

Duration : 2 h, at lower category temperature

8.5.1.5 ***Low air pressure (If required by the detail specification)*** — This test shall be carried out in accordance with 8.5.1.5 of IS : 7305-1984* with the following details:

a) The test shall be carried out at a temperature of 15°C to 35°C and a pressure of **8·5 kPa** shall be used. The duration of the test shall be 1 hour.

b) While still at the specified low pressure and during the last five minutes of the one hour period, the rated voltage shall be applied. The sample part of capacitors submitted to this test shall be sub-divided into two or three parts as necessary and each part submitted to one of the tests laid down under A and B in Table 1 of 8.3.1.8 of IS : 7305-1984*. The test voltage shall be applied to terminations, case, etc, as given in L3.1.2.

c) During and after the test the capacitors shall be visually examined and there shall be no evidence of permanent breakdown, flashover, harmful deformation of the case.

8.5.1.6 ***Damp heat cyclic (remaining cycles)*** — This test shall be carried out in accordance with 8.5.1.6 of IS : 7305-1984* with the following details.

Within 15 minutes after removal from the damp heat test, the rated voltage shall be applied for one minute at test point A using the test circuit conditions given in **8.3.1.**

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*Specification for fixed capacitors used in electronic equipment (*first revision*).

8.5.1.7 Final *measurements and requirements* — After recovery the capacitors shall be inspected and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirement*
Visual examination	8.4.1	There shall be no visible damage. The marking shall be legible.
Capacitance	8.3.2	The percentage difference between the capacitance measured finally and in 8.3.2 shall not exceed 3 percent for grade 1 and 5 percent for grade 2 capacitors
Tan δ	8.3.3.1	The increase of tan δ with respect to tan δ measured in 8.3.3 shall be: $\leqslant 0{\cdot}005$ for $C \leqslant 1\ \mu F$ Grade 1 $\leqslant 0{\cdot}003$ for $C > 1\ \mu F$ Grade 1 $\leqslant 0{\cdot}008$ for $C \leqslant 1\ \mu F$ Grade 2 $\leqslant 0{\cdot}005$ for $C > 1\ \mu F$ Grade 2
Insulation resistance	8.3.4	The insulation resistance shall not be less than 50 percent of the applicable value in 8.3.4.

8.5.2 *Damp Heat (Steady State)* — This test shall be carried out in accordance with 8.5.2 of IS : 7305-1984* with the following details.

8.5.2.1 *Initial measurements*-The capacitance and tangent of loss angle shall be measured.

8.5.2.2 Within 15 minutes after removal from the damp heat test, the voltage proof test according to 8.3.1 shall be carried out, but with the rated voltage applied.

8.5.2.3 *Final measurements and requirements*-Within 2 hours after recovery the capacitors shall be inspected and shall meet the

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***Specification for fixed capacitors used in electronic equipment (*first* revision).**

following requirements:

Measurement	*Measuring Method*	*Requirements*
Visual examination	8.4.1	There shall be no visible damage. The marking shall be legible
Capacitance	8.3.2	The percentage difference between the capacitance measured finally and in 8.5.2.1 shall not exceed 3 percent for Grade 1 and 5 percent for Grade 2 capacitors
Tan δ	8.3.3.1	The increase of tan δ with respect to tan δ measured in 8.5.2.1 shall not exceed 0·005
Insulation resistance	8.3.4	The insulation resistance shall not be less than 50 percent of the applicable values in 8.3.4.

8.5.3 *Rapid Change of Temperature* — This test shall be carried out in accordance with 8.5.3 of IS : 7305-1984* with the following details.

Initial measurement — The capacitance and tangent of loss angle shall be measured.

Number of cycles : 5.

Duration of exposure at the temperature limits — 30 minutes.

8.5.3.1 *Final measurements and requirements* — After the test the capacitors shall be visually examined. There shall be no visible damage.

8.6 Endurance — This test shall be carried out in accordance with 8.6 of IS : 7305-1984* with the following details.

8.6.1 *Initial Measurement* - The capacitance and tangent of loss angle shall be measured.

8.6.2 *Duration of the test* — 2 000 h for Grade 1 and 1 000 h for Grade 2.

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8.6.3 Test voltage and temperature shall be as given below:

Category	-/085/-	-/100/-		-/125/-	
Temperature	85°C	100°C	85°C	125°C	85°C
Voltage (dc)	1·25 U_R	1.25 U_C	1·25 U_R	1.25 U_C	1·25 U_R
Sample part divided into	**1 part**	**2 parts**		**2 parts**	

8.6.3.1 The test voltage shall be applied to each capacitor individually through a resistor whose value R is equal to $\frac{0.022}{C_R}$ Ω where C_R is the rated capacitance in farads and R is the resistance% ohms, and shall be within 30 percent of the calculated value with a maximum of 2 M Ω.

8.6.4 After the specified period, the capacitors shall be allowed to recover and shall then be discharged across the same resistor R as defined in 8.6.3.1.

8.6.5 ***Final Measurements and Requirements*** -The capacitors shall be inspected and shall meet the following requirements:

Measurement	*Measuring Method*	*Requirements*
Visual inspection	8.4.1	There shall be no visible damage. The marking shall be legible
Capacitance	8.3.2	The percentage difference between the capacitances measured finally and in 8.3.2 shall not exceed 3 percent for Grade 1 capacitor 5 percent for Grade 2 capacitor
Tan δ	8.3.3.1	The increase of tan δ with respect to tan δ measured in **8.3.3.1** shall be: ≤0·003 for C ≤ 1 μF Grade 1 ≤0·002 for C > 1 μF Grade 1 ≤0·005 for C ≤ 1 μF Grade 2 ≤0·003 for C > 1 μF Grade 2
Insulation resistance	8.3.4	The insulation resistance shall be not less than 50 percent of the applicable value in *8.3.4.*

(*Continued from page 2*)

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